MIC2133 Evaluation Board User's Guide

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Preface

NOTICE TO CUSTOMERS

All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our website (www.microchip.com) to obtain the latest documentation available.

Documents are identified with a "DS" number. This number is located on the bottom of each page, in front of the page number. The numbering convention for the DS number is "DSXXXXXXXXA", where "XXXXXXXX" is the document number and "A" is the revision level of the document.

For the most up-to-date information on development tools, see the MPLAB® IDE online help. Select the Help menu, and then Topics to open a list of available online help files.

INTRODUCTION

This chapter contains general information that will be useful to know before using the MIC2133 Evaluation Board (EV66P64A). Items discussed in this chapter include:

- Document Layout
- Conventions Used in this Guide
- The Microchip Website
- Customer Support
- Document Revision History

DOCUMENT LAYOUT

This document describes how to use the MIC2133 Evaluation Board (EV66P64A) as a development tool. The manual layout is as follows:

- **Chapter 1. "Product Overview"** – Important information about the MIC2133 Evaluation Board (EV66P64A).
- **Chapter 2. "Installation and Operation"** – Includes instructions on how to get started with the MIC2133 Evaluation Board (EV66P64A) and a description of each function.
- **Appendix A. "Schematic and Layouts"** – Shows the schematic and layout diagrams for the MIC2133 Evaluation Board (EV66P64A).
- **Appendix B. "Bill of Materials (BOM)"** – Lists the parts used to build the MIC2133 Evaluation Board (EV66P64A).
- **Appendix C. "Board Performance Curves and Waveforms"** – Includes the board performance curves and waveforms for the MIC2133 Evaluation Board (EV66P64A).

CONVENTIONS USED IN THIS GUIDE

This manual uses the following documentation conventions:

DOCUMENTATION CONVENTIONS

Description	Represents	Examples
Arial font:		
Italic characters	Referenced books	*MPLAB® IDE User's Guide*
	Emphasized text	...is the *only* compiler...
Initial caps	A window	the Output window
	A dialog	the Settings dialog
	A menu selection	select Enable Programmer
Quotes	A field name in a window or dialog	"Save project before build"
Underlined, italic text with right angle bracket	A menu path	*File>Save*
Bold characters	A dialog button	Click **OK**
	A tab	Click the **Power** tab
N'Rnnnn	A number in verilog format, where N is the total number of digits, R is the radix and n is a digit.	4'b0010, 2'hF1
Text in angle brackets < >	A key on the keyboard	Press <Enter>, <F1>
Courier New font:		
Plain Courier New	Sample source code	`#define START`
	Filenames	`autoexec.bat`
	File paths	`c:\mcc18\h`
	Keywords	`_asm, _endasm, static`
	Command-line options	`-Opa+, -Opa-`
	Bit values	`0, 1`
	Constants	`0xFF, 'A'`
Italic Courier New	A variable argument	*`file`*`.o`, where *`file`* can be any valid filename
Square brackets [ ]	Optional arguments	`mcc18 [options]` *`file`* `[options]`
Curly brackets and pipe character: { | }	Choice of mutually exclusive arguments; an OR selection	`errorlevel {0|1}`
Ellipses...	Replaces repeated text	`var_name [, var_name...]`
	Represents code supplied by user	`void main (void) { ... }`

THE MICROCHIP WEBSITE

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- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

CUSTOMER SUPPORT

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Field Application Engineer (FAE)
- Technical Support

Customers should contact their distributor, representative or field application engineer (FAE) for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in the back of this document.

Technical support is available through the website at:
https://www.microchip.com/support.

DOCUMENT REVISION HISTORY

Revision A (July 2022)

- Initial release of this document.

NOTES:

Chapter 1. Product Overview

1.1 INTRODUCTION

This chapter provides an overview of the MIC2133 Evaluation Board (EV66P64A) and covers the following topics:

- MIC2133 Overview
- MIC2133 Key Features
- MIC2133 Evaluation Board (EV66P64A) Kit Contents

1.2 MIC2133 OVERVIEW

MIC2133 is constant on-time, dual phase synchronous buck controller featuring a unique adaptive ON-time control architecture with HyperLight Load and phase-shedding features enabled. MIC2133 can be used with external MOSFETs and output filter to create a dual phase single output, high current switch mode power supply. It also operates over an input supply range from 4.5V to 75V and can be used to supply up to 50A of output current. The output voltage is adjustable down to 0.6V with a guaranteed accuracy of ±1%. The device operates with programmable switching frequency from 100 kHz to 800 kHz per phase. MIC2133 is available in a 5 x 5 mm 32-pin VQFN package with a junction operating range from -40°C to +125°C.

The 75V rating of this device makes it attractive for applications such as communication, automotive and industrial, which have increasing requirements for additional voltage safety headroom.

1.3 MIC2133 KEY FEATURES

The MIC2133 Evaluation Board (EV66P64A) has the following features:

- Input Voltage Range: 4.5V to 75V
- Adjustable Output Voltage Range: 0.6V to 32V
- Adaptive Constant on Time Control
  - High Delta V Operation
  - Any Capacitor™ Stable
- 0.6V Internal Reference with ±1% Accuracy
- Ripple Injection from Third Node which allows Greater Than 50% Duty Cycles
- HyperLight Load and Phase Shedding
- Automatic Phase Shedding of Secondary Phase
- Accurate Current Balancing between Phases
- Accurate Phasing Between Phases that Are Always 180° Out of Phase
- 100 kHz To 800 kHz Switching Frequency Per Phase
- High Voltage Internal 5V LDO for Single Supply Operation
- Secondary LDO To Improve System Efficiency
- Supports Start Up To Pre-bias Output
- Remote Sense Amplifier for Tight Output Regulation
- Supports Adaptive Voltage Positioning (AVP) or Droop

- Precision Enable Function for Low Stand-by Current
- External Programmable Soft Start to Reduce Inrush Current
- Programmable Current Limit and Hiccup Short Circuit Protection
- Thermal Shut Down With Hysteresis
- Die Temperature Sense
- Compact size: 5 x 5 mm 32-pin VQFN package
- -40°C to +125°C Junction Temperature Range

1.4 MIC2133 EVALUATION BOARD (EV66P64A) KIT CONTENTS

The MIC2133 Evaluation Board (EV66P64A) kit includes:

- MIC2133 Evaluation Board (EV66P64A)
- Important Information Sheet

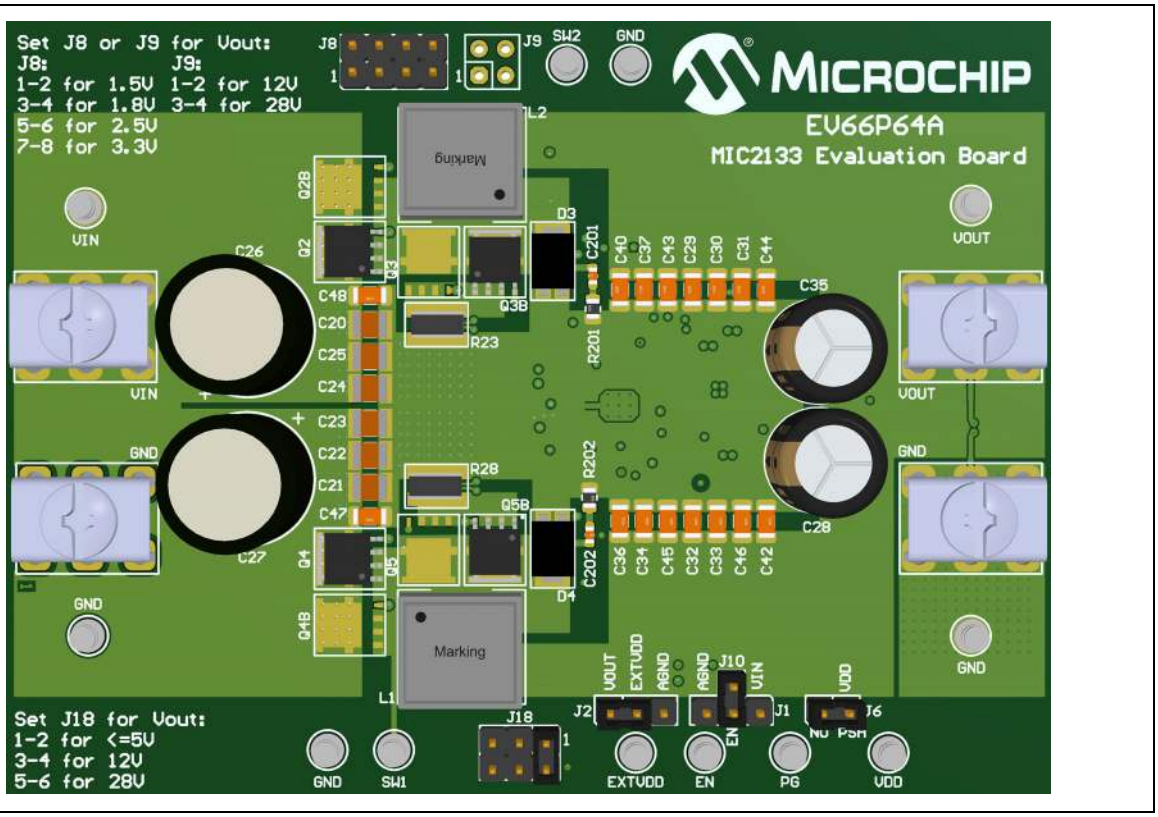


FIGURE 1-1: *Typical MIC2133 Evaluation Board (EV66P64A) Top.*

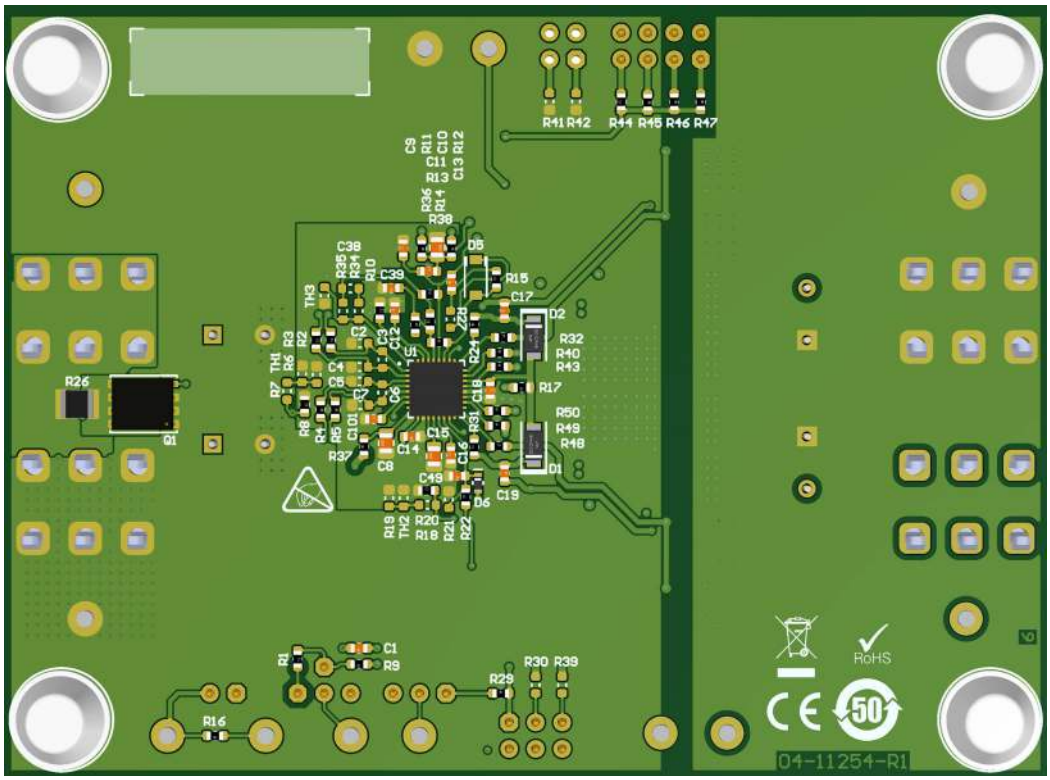


FIGURE 1-2: *Typical MIC2133 Evaluation Board (EV66P64A) Bottom.*

NOTES:

Chapter 2. Installation and Operation

2.1 INTRODUCTION

The MIC2133 Evaluation Board (EV66P64A) is fully assembled and tested to evaluate and demonstrate the MIC2133 capabilities. The board is based on a buck topology and can deliver an adjustable output voltage between 1.5V and 5V, with a maximum current of 50A when is supplied with 10-75V at the input. It should be noted, however, that the board is tuned and optimized for a 5V/15A output.

2.1.1 Powering the MIC2133 Evaluation Board

The board's power supply requires an output capability of at least 1A and a voltage range of 10 to 75V, at a minimum of 100W. A proper resistor or an electronic load device capable to sustain output voltage and current can be used as a load (see Figure 2-1).

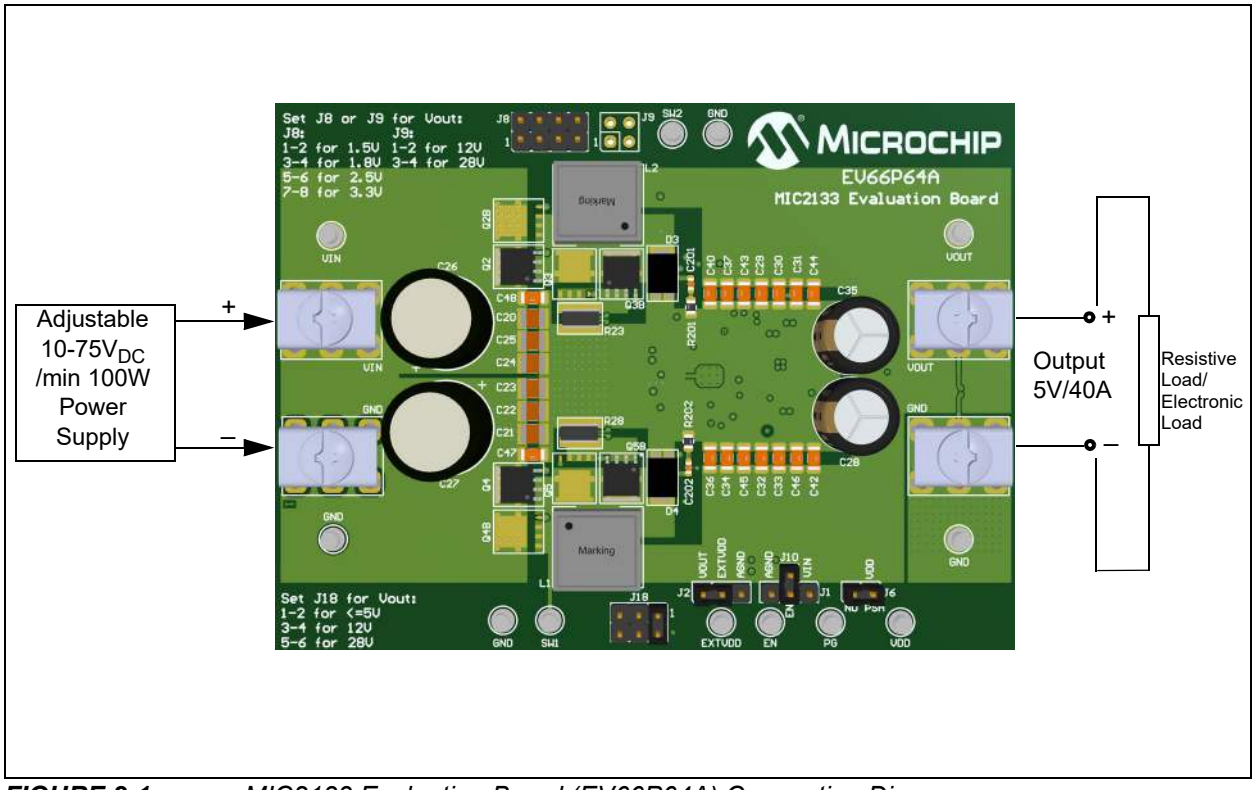


FIGURE 2-1: *MIC2133 Evaluation Board (EV66P64A) Connection Diagram.*

2.2 SETUP AND CONFIGURATION

2.2.1 IC

To enable IC, a jumper should be placed vertically on J10, (between the J10-1 and J1-2 connectors, as in Figure 2-1).

2.2.2 LDO

To use the internal high voltage LDO, a jumper should be placed on connectors J2-2 and J2-3 else.

To use an external power supply, the same jumper must be removed and an external voltage in the range of 4.7V to 13V should be supplied to the EXTVDD and AGND connectors.

To bypass the internal high voltage LDO, a jumper should be placed between the J2-1 (VOUT) and J2-2 (EXTVDD) connectors, if the output voltage is greater than 4.7V.

2.2.3 Voltage

The board's output voltage (either 1.5V, 1.8V, 2.5V, 3.3V, or 5V) is set by placing jumpers in the desired configuration. The selection for the desired output voltage can be made by plugging a jumper in the vertical position on the J8 connector (as in the table in the top left of the board) and a jumper must be placed vertically on the J18 connector, on its first right hand position.

Note: With no jumper on the J8 connector, the default output voltage is 5V.

EXAMPLE 2-1: CALCULATION OF R_{ILIM} FOR BOTTOM MOSFET R_{DSON} CURRENT SENSING

$$I_{LIM} = \frac{0.3V - (0.25 \cdot V_{ILIM})}{R_{DSON}} \quad (1)$$

$$V_{ILIM} = 1.2V - (4 \cdot R_{DSON} \cdot I_{LIM}) \quad (2)$$

For I_{LIM} = 15A per phase, R_{DSON} = 10mΩ at 25°C, using equation (2) V_{ILIM} = 1.2V-4* 10mΩ *15A.

V_{ILIM} = 0.6V, to get on I_{LIM} pin at 10 µA constant over temperature current we need a programming equivalent resistor of R_{ILIM} = 0.6V/10 µA = 60 kΩ.

EXAMPLE 2-2: CALCULATION OF THE FEEDBACK DIVIDER FOR 5V

$$R_{FB(BOT)} = \frac{R_{FB(TOP)}}{\frac{V_{OUT}}{V_{REF}} - 1} \quad (3)$$

For V_{OUT} = 5V with $R_{FB(TOP)}$ = 22 kΩ and V_{REF} = 0.6 V, using equation (3) $R_{FB(BOT)}$ = 22 kΩ/(5V/0.6V-1) which results in $R_{FB(BOT)}$ = 3 kΩ.

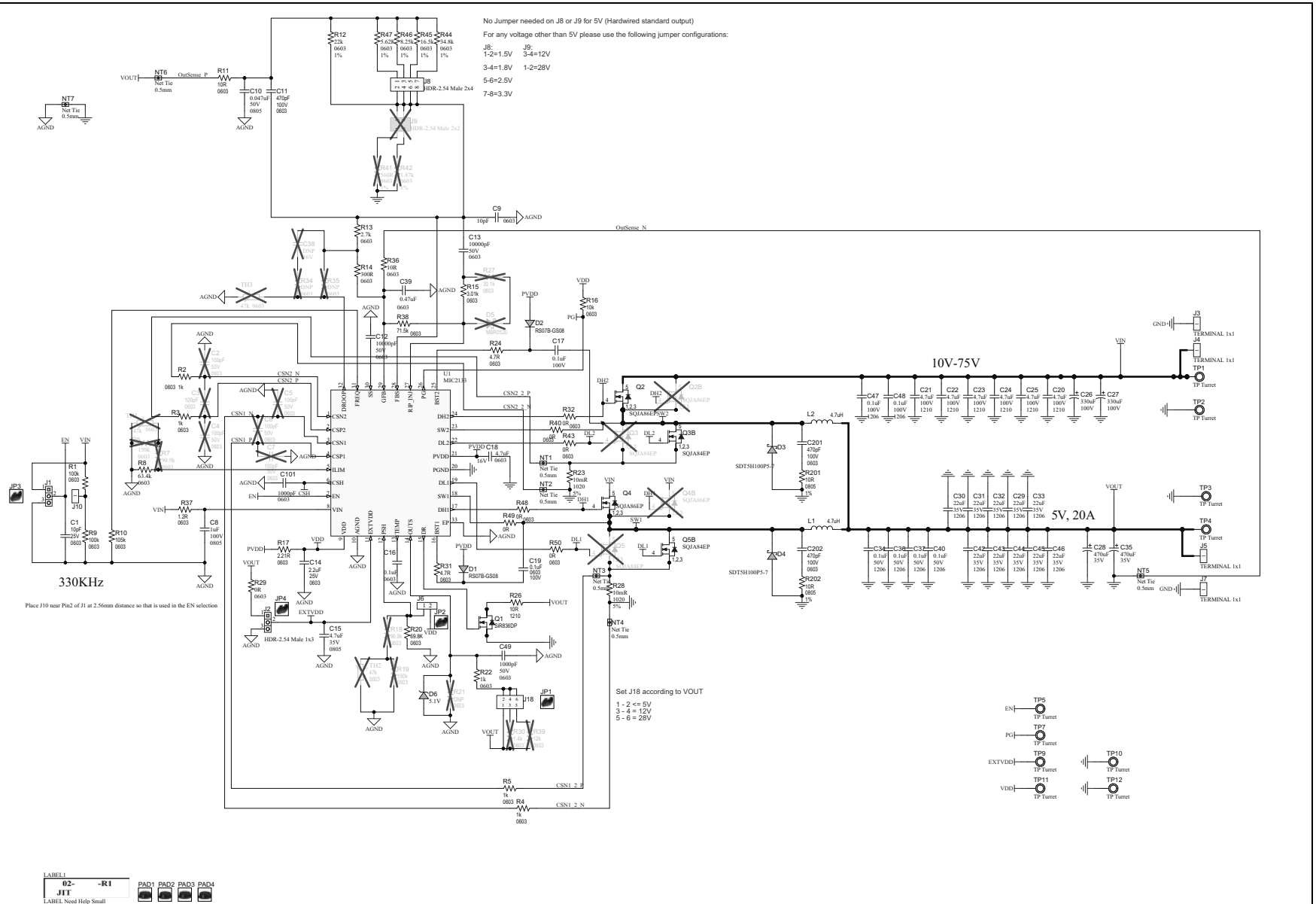
Appendix A. Schematic and Layouts

A.1 INTRODUCTION

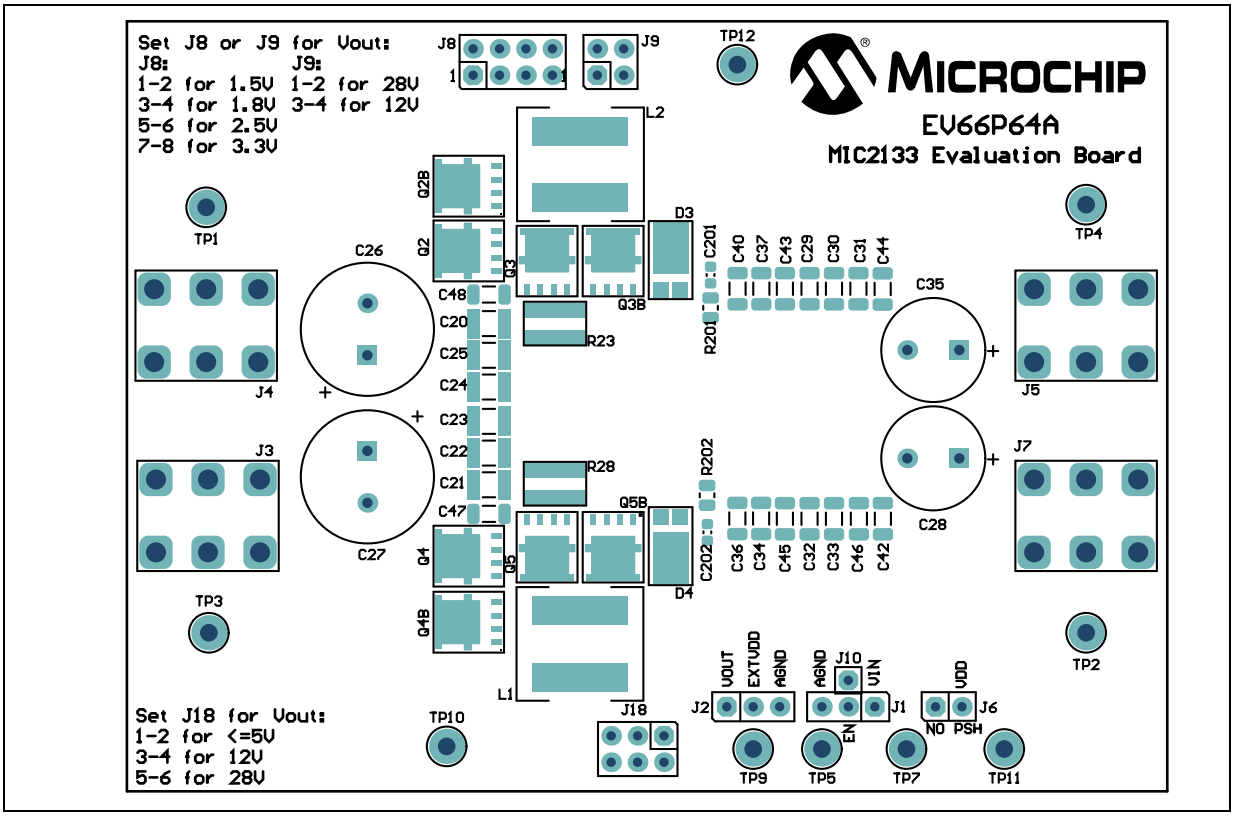
This appendix contains the following schematic and layouts of the MIC2133 Evaluation Board:

- EV66P64A Board – Schematic
- EV66P64A Board – Top Silk
- EV66P64A Board – Top Copper and Silk
- EV66P64A Board – Top Copper
- EV66P64A Board – Inner 1 Copper
- EV66P64A Board – Inner 2 Copper
- EV66P64A Board – Inner 3 Copper
- EV66P64A Board – Inner 4 Copper
- EV66P64A Board – Bottom Silk
- EV66P64A Board – Bottom Copper and Silk
- EV66P64A Board – Bottom Copper

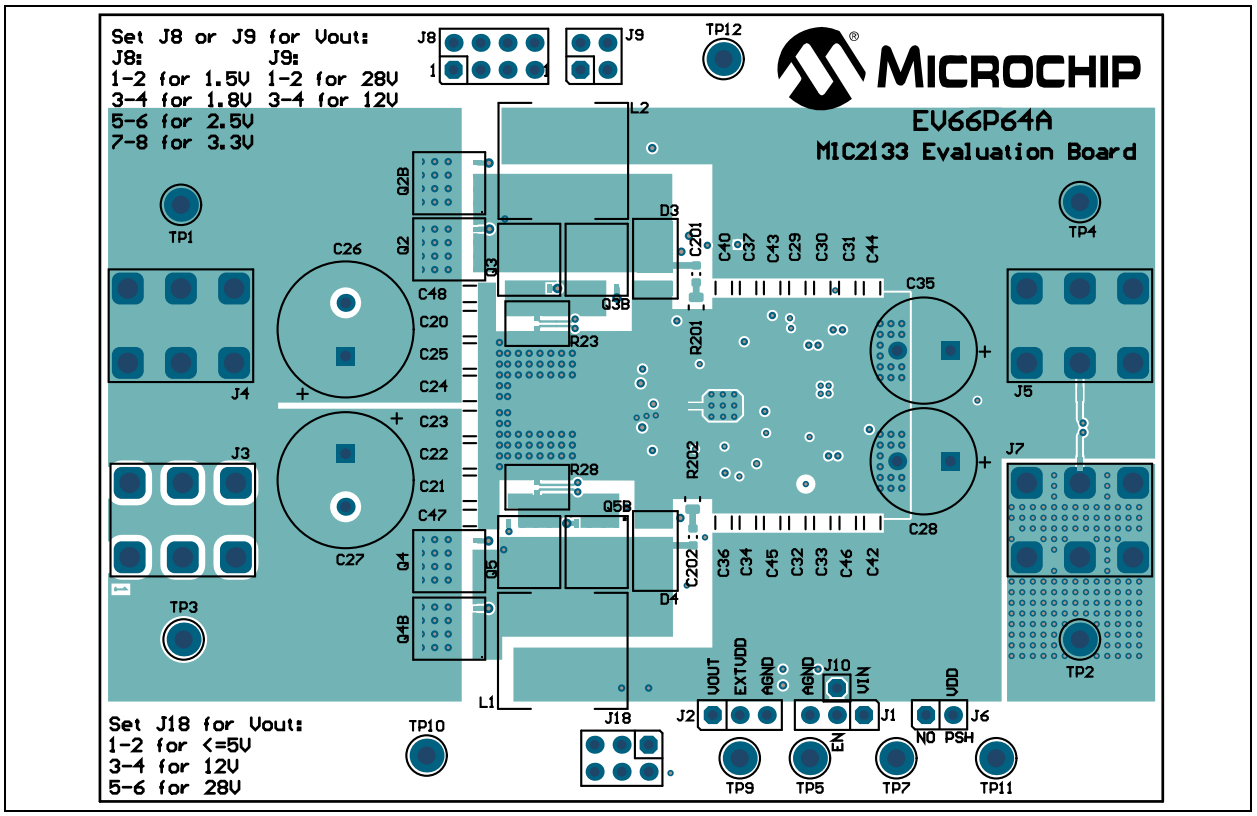
A.2 EV66P64A BOARD – SCHEMATIC



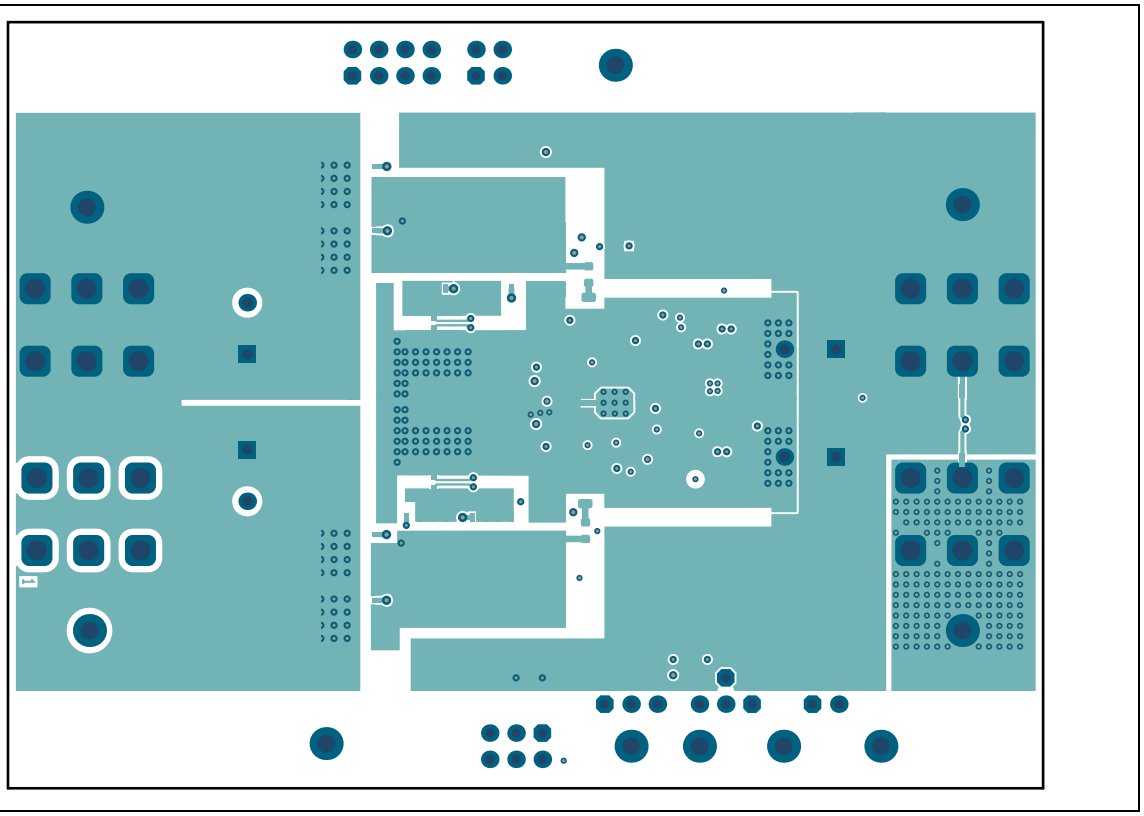
A.3 EV66P64A BOARD – TOP SILK



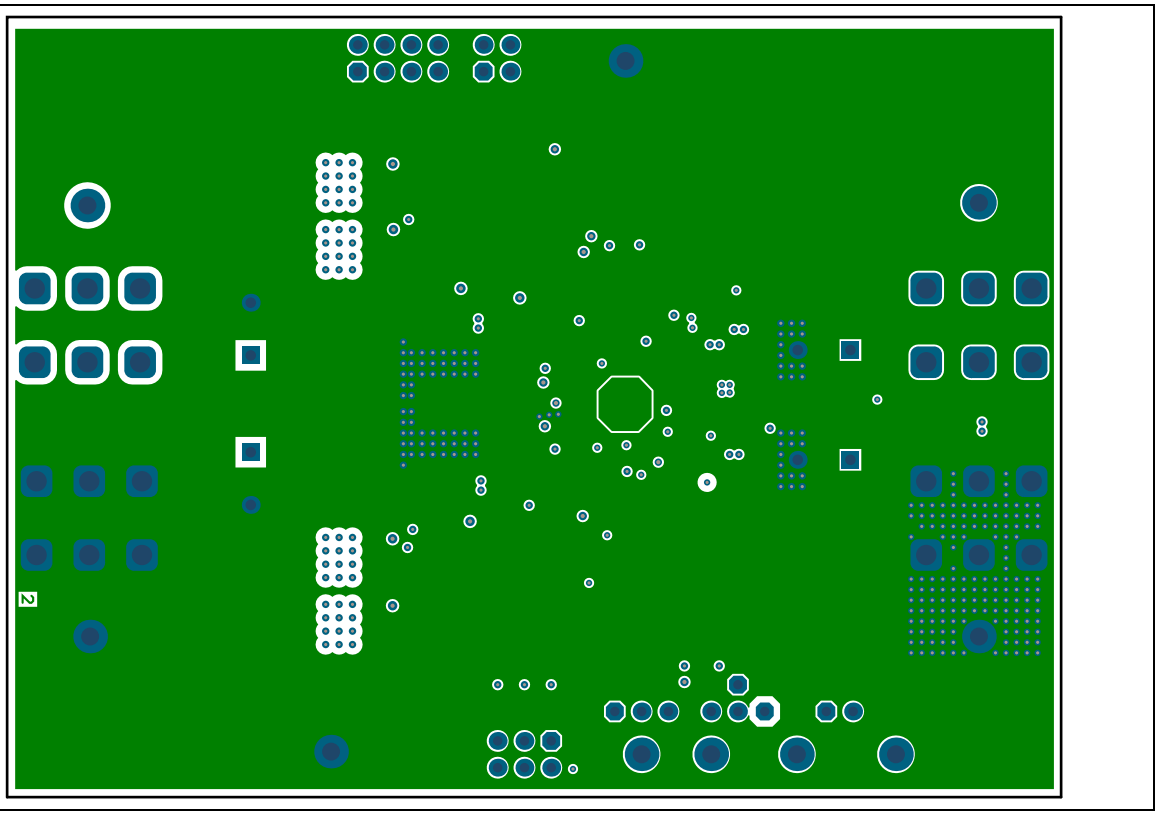
A.4 EV66P64A BOARD – TOP COPPER AND SILK



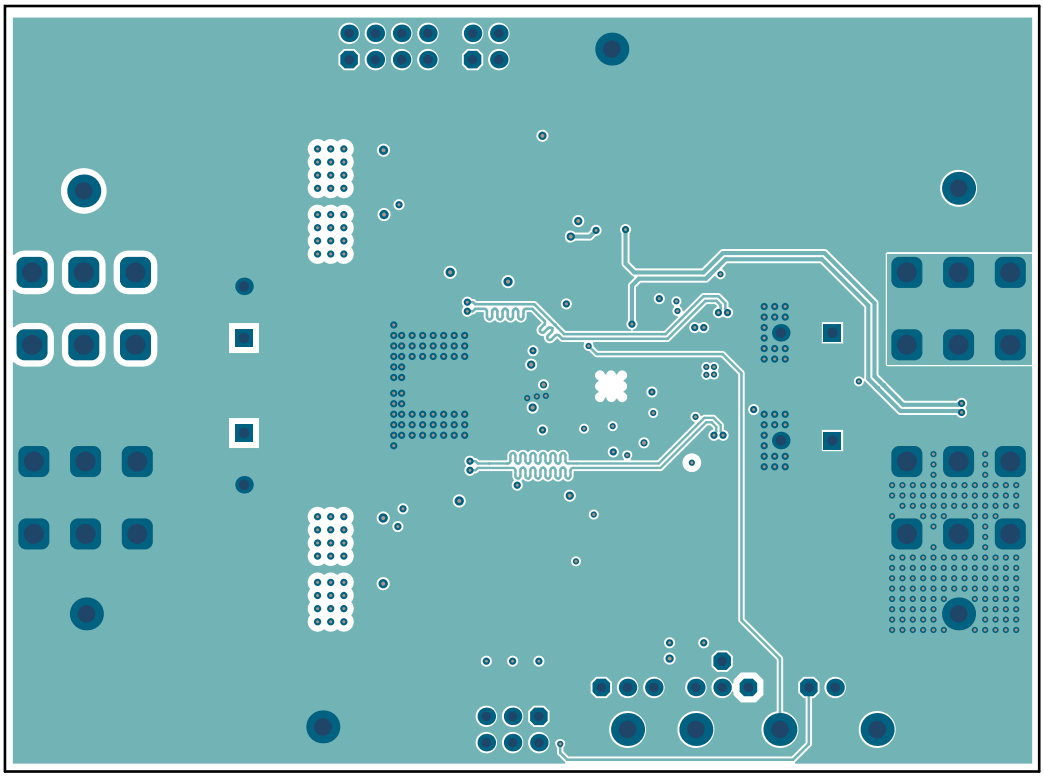
A.5 EV66P64A BOARD – TOP COPPER



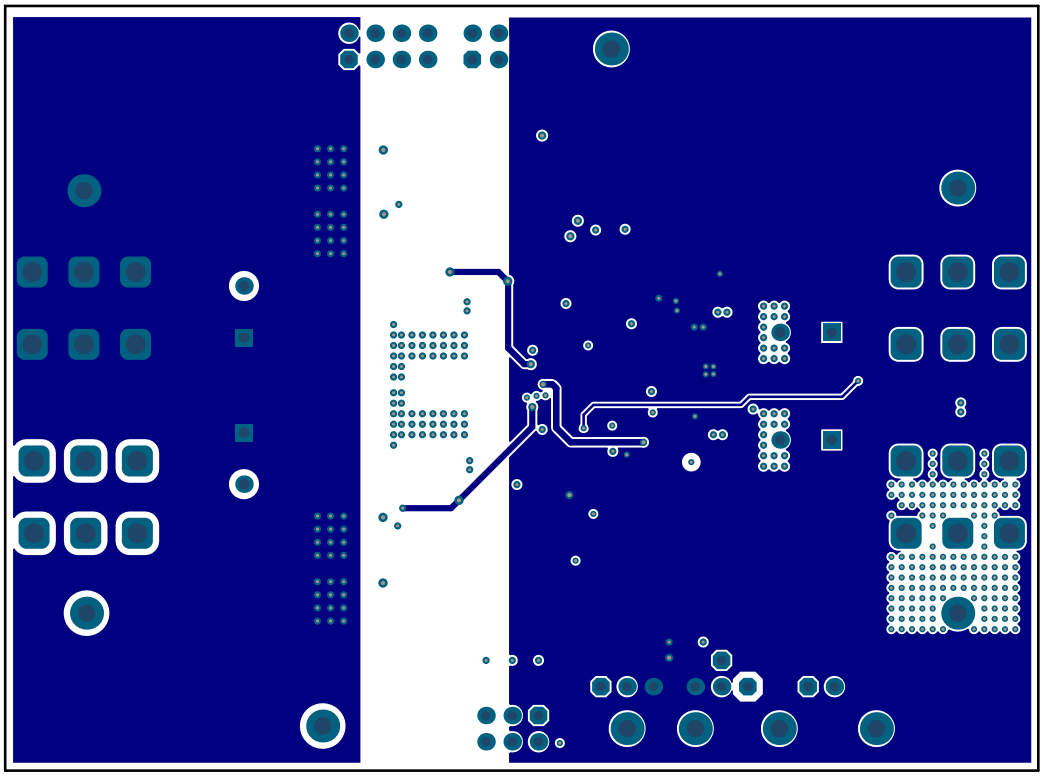
A.6 EV66P64A BOARD – INNER 1 COPPER



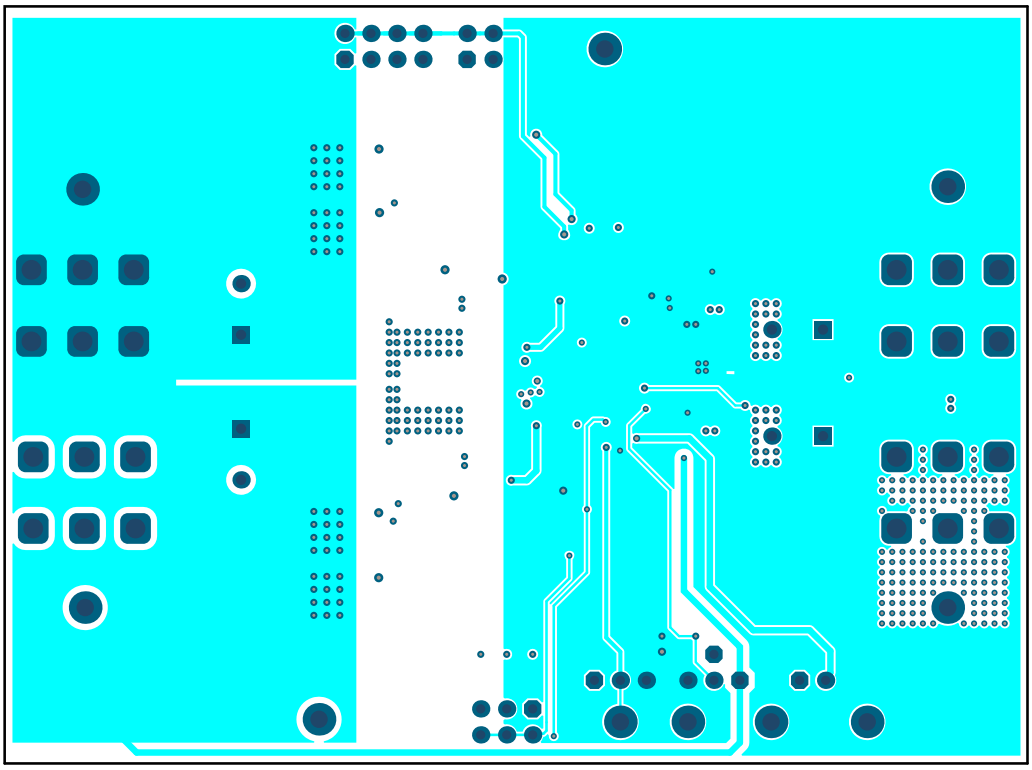
A.7 EV66P64A BOARD – INNER 2 COPPER



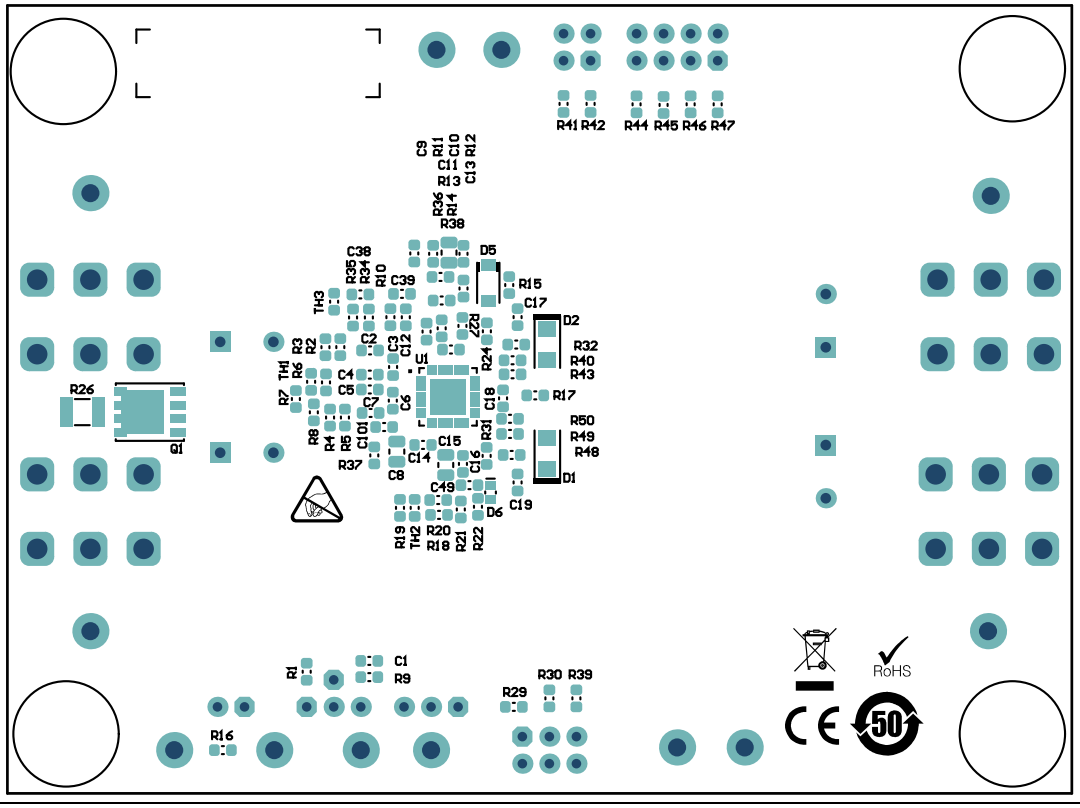
A.8 EV66P64A BOARD – INNER 3 COPPER



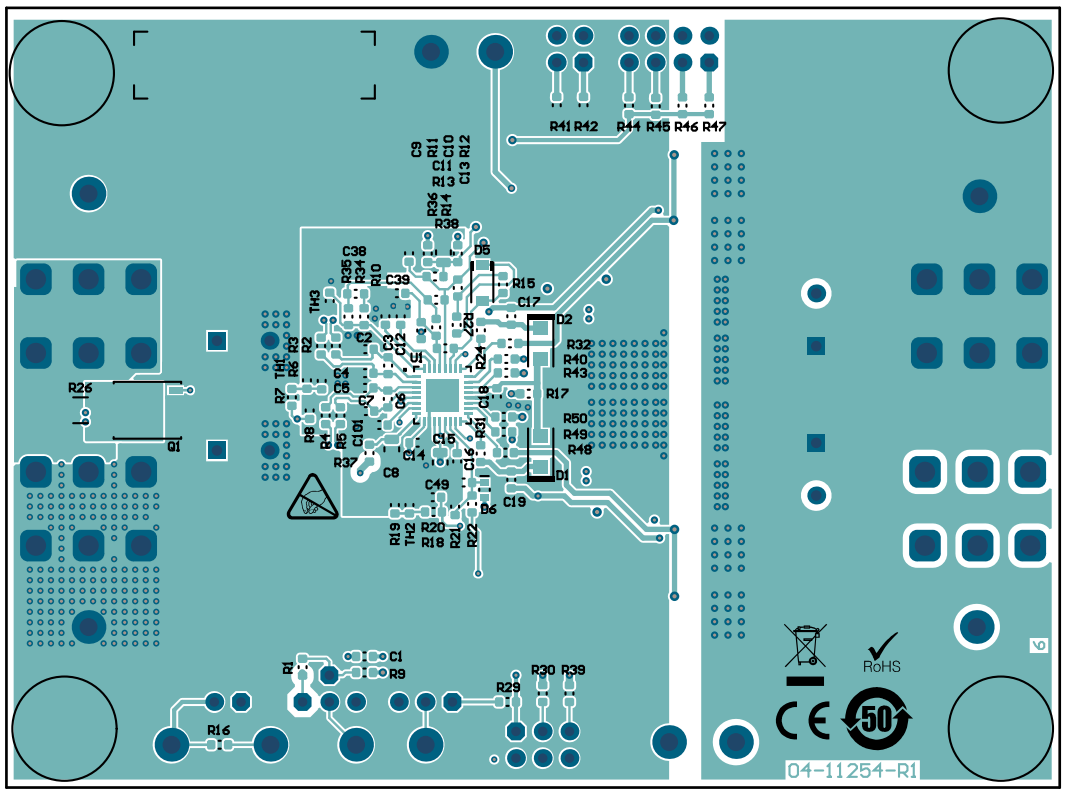
A.9 EV66P64A BOARD – INNER 4 COPPER



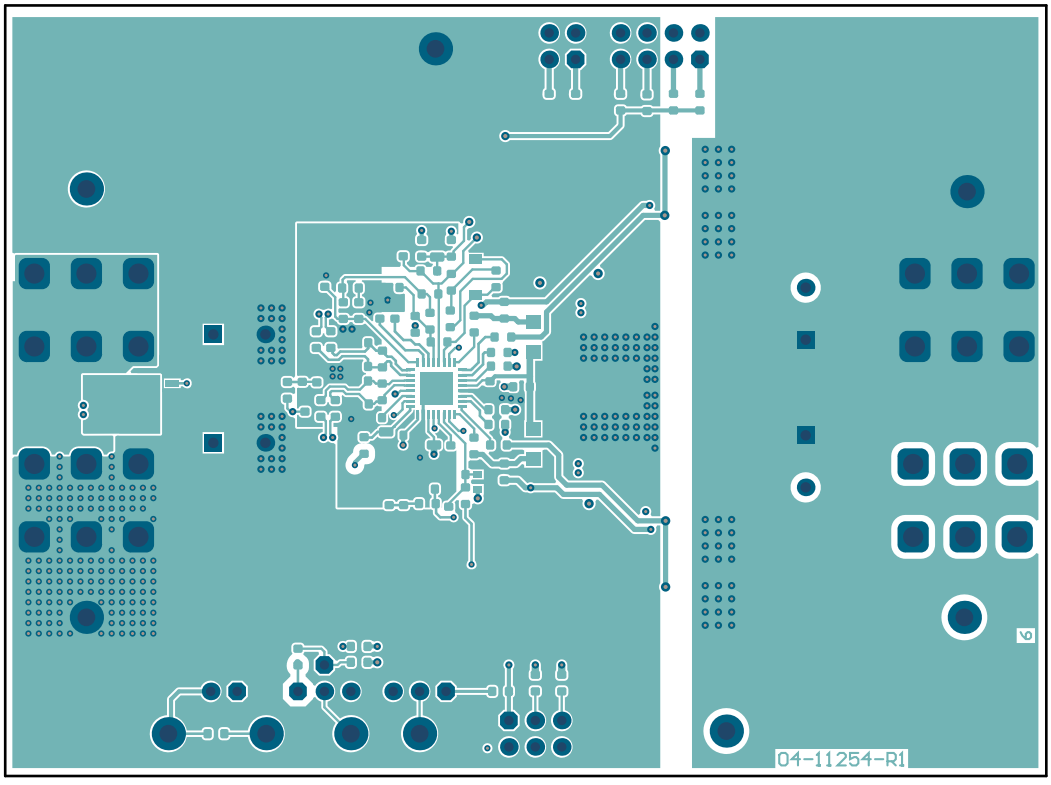
A.10 EV66P64A BOARD – BOTTOM SILK



A.11 EV66P64A BOARD – BOTTOM COPPER AND SILK



A.12 EV66P64A BOARD – BOTTOM COPPER



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Appendix B. Bill of Materials (BOM)

TABLE B-1: BILL OF MATERIALS (BOM)

Qty.	Reference	Description	Manufacturer	Part Number
1	C1	Ceramic, capacitor, 10pF, 25V, 10%, NP0, SMD, 0603	Kyocera AVX	06033A100KAT2A
1	C8	Ceramic, capacitor, 1uF, 100V, 10%, X7S, SMD, 0805	TDK Corporation	C2012X7S2A105K125AB
1	C9	Ceramic, capacitor, 10pF, 50V, 0.5pF, C0G, SMD, 0603	TDK Corporation	C1608C0G1H100D080AA
1	C10	Ceramic, capacitor, 0.047uF, 50V, 20%, Y5V, SMD, 0805	Kyocera AVX	08055G473ZAT2A
3	C11, C201, C202	Ceramic, capacitor, 470pF, 100V, 5%, C0G, SMD, 0603	TDK Corporation	CGA3E2C0G2A471J080AA
2	C12, C13	Ceramic, capacitor, 10000pF, 50V, 10%, X7R, SMD, 0603	KEMET	C0603C103K5RACTU
1	C14	Ceramic, capacitor, 2.2uF, 25V, 10%, X5R, SMD, 0603	Murata Electronics®	GRM188R61E225KA12D
1	C15	Ceramic, capacitor, 4.7uF, 35V, 10%, X7R, SMD, 0805	TDK Corporation	C2012X7R1V475K125AE
1	C16	Ceramic, capacitor, 0.1uF, 16V, 10%, X7R, SMD, 0603,	Taiyo Yuden Co., Ltd.	EMK107B7104KA
2	C17, C19	Ceramic, capacitor, 0.1uF, 100V, 10%, X7R, SMD, 0603	Murata Electronics	GRM188R72A104KA35D
1	C18	Ceramic, capacitor, 4.7uF, 16V, 10%, X5R, SMD, 0603	TDK Corporation	C1608X5R1C475K080AC
6	C20, C21, C22, C23, C24, C25	Ceramic, capacitor, 4.7uF, 100V, 10%, X7S, SMD, 1210, AEC-Q200	Taiyo Yuden Co., Ltd.	HMK325C7475KMHPE
2	C26, C27	Capacitor, aluminum, 330uF, 100V, 20%, RAD, P5D12.5H25	Nichicon Corporation	UFW2A331MHD
2	C28, C35	Capacitor, aluminum, 470uF 35V 20% RAD P5D10H20	United Chemi-Con	EKZE350ELL471MJ20S
10	C29, C30, C31, C32, C33, C42, C43, C44, C45, C46	Ceramic, capacitor, 22uF, 35V, 20%, X5R, SMD, 1206	TDK Corporation	C3216X5R1V226M160AC
4	C34, C36, C37, C40	Ceramic, capacitor, 0.1uF, 50V, 10%, X7R, SMD, 1206	Yageo Corporation	CC1206KRX7R9BB104
1	C39	Ceramic, capacitor, 0.47uF, 25V, 10%, X7R, SMD, 0603	Murata Electronics	GRM188R71E474KA12D
2	C47, C48	Ceramic, capacitor, 0.1uF, 100V, 10%, X7R, SMD, 1206	Yageo Corporation	CC1206KKX7R0BB104
2	C49, C101	Ceramic, capacitor,1000pF, 50V, 10%, X7R, SMD, 0603	Wurth Elektronik	885012206083

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

TABLE B-1: BILL OF MATERIALS (BOM) (CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
2	D1, D2	Diode, rectifier, RS07B-GS08, 100V, 500mA, SMD, DO-219AB	Vishay Semiconductors	RS07B-GS08
2	D3, D4	Diode, Schottky, RS07B-GS08, 100V, 5A, SMD, Power DI-5	Diodes Incorporated®	SDT5H100P5-7
1	D6	Diode, Zener, DZ2705100L 5.1V, 120mW, SMD, SOD-523	Panasonic - SSG	DZ2705100L
2	J1, J2	Connector, header-2.54, male, 1x3, Gold, 5.84MH, TH, vertical	Amphenol ICC	68000-103HLF
4	J3, J4, J5, J7	Connector, terminal, 30A, female, 1x1, TH, vertical	Keystone® Electronics Corp.	8197
1	J6	Connector, header-2.54, male, 1x2, Gold, 5.84MH, TH, vertical	Amphenol ICC (FCI)	77311-118-02LF
1	J8	Connector, header-2.54, male, 2x4, Gold, 5.84MH, TH, vertical	Wurth Elektronik	61300821121
1	J10	Connector, header-2.54, male, 1x1, Gold, 5.84MH, TH, vertical	Samtec, Inc.	TSW-101-07-S-S
1	J18	Connector, header-2.54, male, 2x3, Gold, 5.84MH, TH, vertical	Samtec, Inc.	TSW-103-08-L-D
2	L1, L2	Inductor, 4.7uH, 27A, 20%, SMD, L11.6W10.5H8.8	Wurth Elektronik	74439369047
1	Q1	Transistor, FET, N-Ch, SiR836DP, 40V, 21A, 15.6W, PPAK, SO-8	Vishay Siliconix	SIR836DP-T1-GE3
2	Q2, Q4	Transistor, FET, N-Ch, SQJA86EP, 80V, 30A, Power-PAK, SO-8, L AEC-Q101	Vishay Siliconix	SQJA86EP-T1_GE3
2	Q3B, Q5B	Transistor, FET, N-Ch, SQJA84EP, 80V, 46A, Power-PAK, SO-8, L AEC-Q101	Vishay Siliconix	SQJA84EP-T1_GE3
2	R1, R9,	Resistor, TF, 100k, 1%, 1/8W, SMD, 0603	Vishay Beyschlag	MCT06030C1003FP500
4	R2, R3, R4, R5	Resistor, TF, 1k, 0.1%, 1/10W, SMD, 0603	Panasonic® - ECG	ERA-3AEB102V
1	R8	Resistor, TKF, 63.4k, 1%, 1/10W, SMD, 0603, AEC-Q200	Panasonic - ECG	ERJ-3EKF6342V
1	R10	Resistor, TKF, 105k, 1%, 1/16W, SMD, 0603	Panasonic - ECG	ERJ-3EKF1053V
2	R11, R36	Resistor, TKF, 10R, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ3EKF10R0V
1	R12	Resistor, TKF, 22k, 1%, 1/10W, SMD, 0603	SEI	RMCF0603FT22K0
1	R13	Resistor, TKF, 2.7k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF2701V
1	R14	Resistor, TKF, 300R, 1%, 1/10W, SMD, 0603	Yageo Corporation	R0603FR-07300RL
1	R15	Resistor, TKF, 3.01k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF3011V
1	R16	Resistor, TKF, 10k, 1%, 1/16W, SMD, 0603	Noehm Componenti S.r.l.	CPF0603F10KC1

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

TABLE B-1: BILL OF MATERIALS (BOM) (CONTINUED)

Qty.	Reference	Description	Manufacturer	Part Number
1	R17	Resistor, TF, 2.21R, 0.1%, 1/16W, SMD, 0603	Stackpole Electronics, Inc.	RNCF0603BKC2R21
1	R20	Resistor, TF, 69.8K, 0.1%, 1/10W, SMD, 0603	Panasonic - ECG	ERA-3AEB6982V
11	R22	Resistor, TKF, 1k, 1%, 1/10W, SMD, 0603 AEC-Q200	Panasonic - ECG	ERJ3EKF1001V
2	R23, R28	Resistor, TKF, 10mR, 5%, 2W, SMD, 1020 AEC-Q200	Vishay/Dale	RCWE102010L0JNEA
2	R24, R31	Resistor, TKF, 4.7R 1% 1/10W SMD 0603	Panasonic - ECG	ERJ-3RQF4R7V
1	R26	Resistor, TKF, 10R, 1%, 1/2W, SMD, 1210	Stackpole Electronics, Inc.	RMCF1210FT10R0
7	R29, R32, R40, R43, R48, R49, R50	Resistor, TKF, 0R, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3GEY0R00V
1	R37	Resistor, TKF, 1.2R, 1%, 1/10W, AEC-Q200, SMD 0603	Panasonic - ECG	ERJ-3RQF1R2V
1	R38	Resistor, TKF, 71.5k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF7152V
1	R44	Resistor, TKF, 34.8k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF3482V
1	R45	Resistor, TKF, 16.5k, 1%, 1/10W, SMD, 0603, AEC-Q200	Panasonic - ECG	ERJ3EKF1652V
1	R46	Resistor, TKF, 8.25k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ3EKF8251V
1	R47	Resistor, TKF, 5.62k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF5621V
2	R201, R202	Resistor, TKF, 10R, 1%, 1/8W, SMD, 0805	Vishay/Dale	CRCW080510R0FKEAC
12	TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12	Connector, TP, Pin, Tin, TH	Harwin Plc.	H2121-01

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

TABLE B-2: BILL OF MATERIALS (BOM) – MICROCHIP PARTS

Qty.	Reference	Description	Manufacturer	Part Number
1	U1	Microchip Analog 75V Dual Phase COT Switching Buck Controller, MIC2133, QFN-32	Microchip Technology Inc.	MIC2132YML-TR

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

TABLE B-3: BILL OF MATERIALS (BOM) – MECHANICAL PARTS

Qty.	Reference	Description	Manufacturer	Part Number
4	JP1, JP2, JP3, JP4	Mechanical, hardware, jumper, 2.54mm, 1x2	3M	969102-0000-DA
4	PAD1, PAD2, PAD3, PAD4	Mechnical, hardware, rubber pad, cylindrical flat top, D8H2.8, black	3M	SJ5076BLACK

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

TABLE B-4: BILL OF MATERIALS (BOM) – DO NOT POPULATE PARTS

Qty.	Reference	Description	Manufacturer	Part Number
6	C2, C3, C4, C5, C6, C7	Capacitor, ceramic, 100pF, 50V, 10%, X7R, SMD, 0603	Vishay Vitramon	VJ0603Y101KXACW1BC
1	C38	Capacitor, ceramic, 1uF, 16V, 10%, X5R, SMD, 0603	Kyocera AVX	0603YD105KAT2A/4K
1	D5	Diode, Schottky, RS07B-GS08, 100V, 5A, SMD, MBR0520, 385mV, 500mA, 20V, SOD-123	ON Semiconductor	MBR0520L
1	J9	Connector, header-2.54, male, 2x2, Gold, 5.84MH, TH, verticalT	Samtec, Inc.	TSW-102-07-G-D
2	Q2B, Q4B	Transistor, FET, N-Ch, SQJA86EP, 80V, 30A, PowerPAK, SO-8L AEC-Q101	Vishay Siliconix	SQJA86EP-T1_GE3
2	Q3, Q5	Transistor, FET, N-Ch, SQJA84EP, 80V, 46A, PowerPAK, SO-8, L AEC-Q101	Vishay Siliconix	SQJA84EP-T1_GE3
2	R6, R19	Resistor, TKF, 150k, 1%, 1/8W, SMD, 0603	KOA Speer Electronics, Inc.	SG73S1JTTD1503F
2	R7, R18	Resistor, TKF, 90.9k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF9092V
1	R21	Resistor, TKF, 0R, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3GEY0R00V
1	R27	Resistor, TF, 30.1k, 0.1%, 1/10W, SMD, 0603	Susumu Co., Ltd.	RG1608P-3012-B-T5
1	R30	Resistor, TKF, 1.4k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF1401V
2	R34, R35	Resistor, TKF, 39k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF3902V
1	R39	Resistor, TKF, 12k, 1%, 1/10W, SMD, 0603	Stackpole Electronics, Inc.	RMCF0603FT12K0
1	R41	Resistor, TKF, 560R, 1%, 1/10W, SMD, 0603	Yageo Corporation	RC0603FR-07560RL
1	R42	Resistor, TKF, 1.87k, 1%, 1/10W, SMD, 0603	Panasonic - ECG	ERJ-3EKF1871V
3	TH1, TH2, TH3	Resistor, Thermistor, 47k, 1%, 100mW, SMD, 0603	Murata Electronics	NCU18WB473F60RB

Note 1: The components listed in this Bill of Materials are representative of the PCB assembly. The released BOM used in manufacturing uses all RoHS-compliant components.

Appendix C. Board Performance Curves and Waveforms

C.1 REFERENCE DESIGN PERFORMANCE

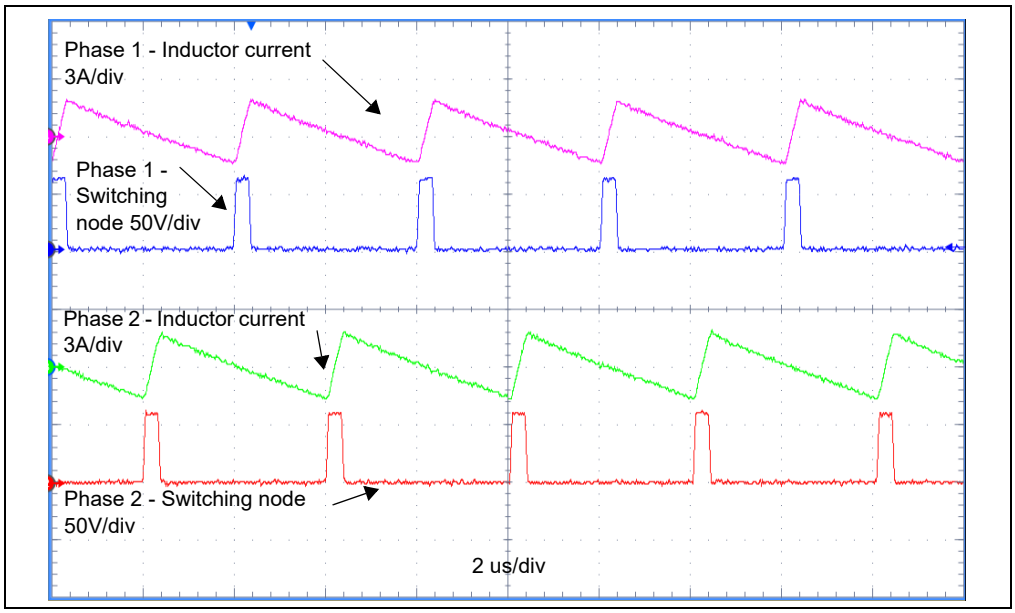

FIGURE C-1: *Switching Node Waveforms for V_{IN} 60V, V_{OUT} 5V and No Load.*

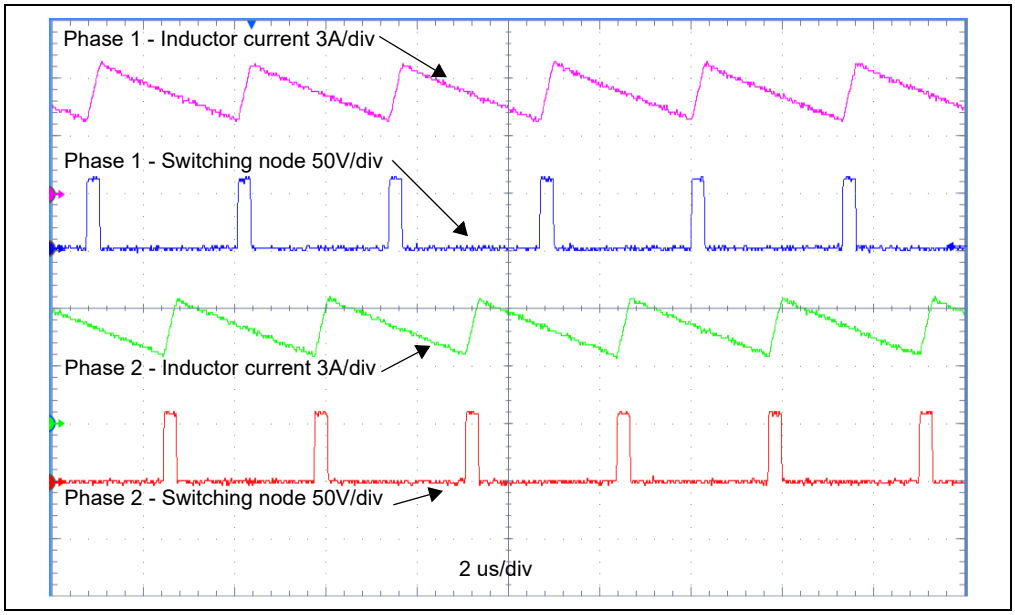

FIGURE C-2: *Switching Node Waveforms for V_{IN} 60v, V_{OUT} 5v and Iout 10A.*

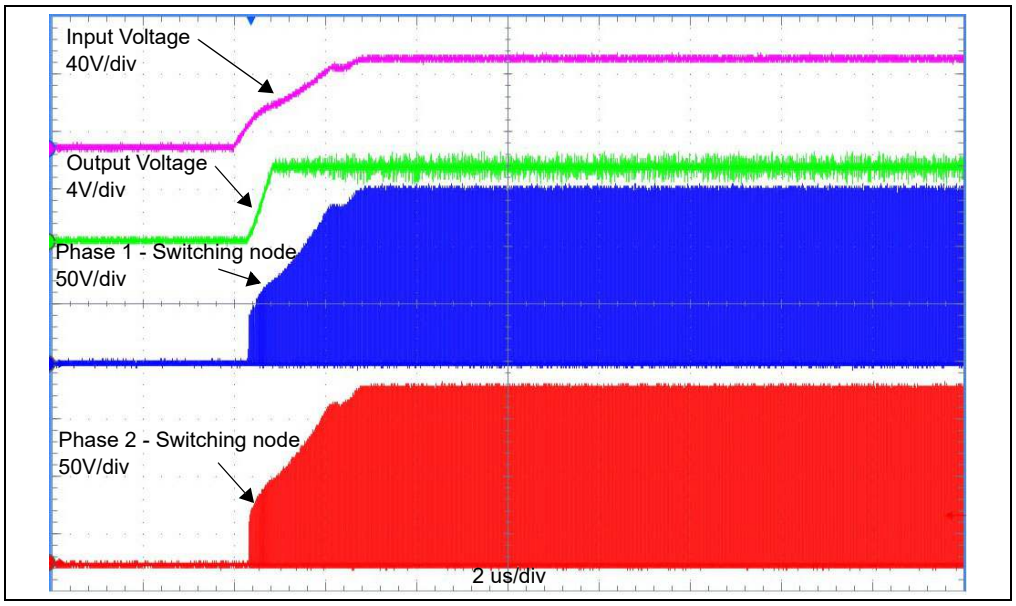

FIGURE C-3: *Soft Start.*

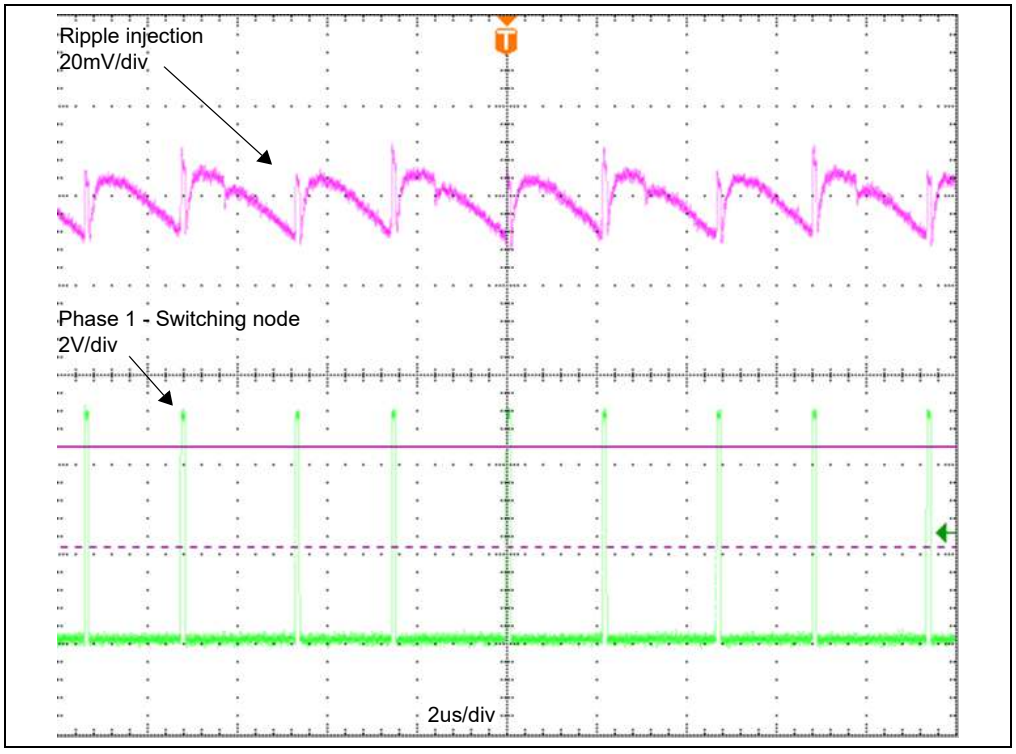

FIGURE C-4: *Ripple Injection.*

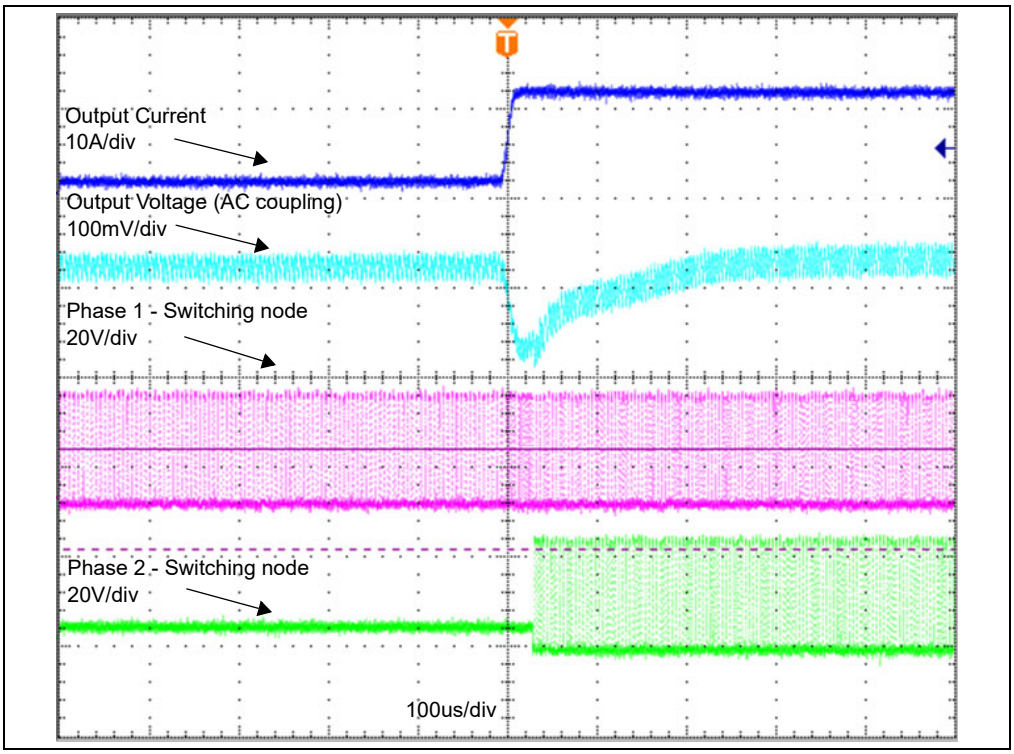

FIGURE C-5: *Load Transient with PSH from 2A to 12A at 24V.*

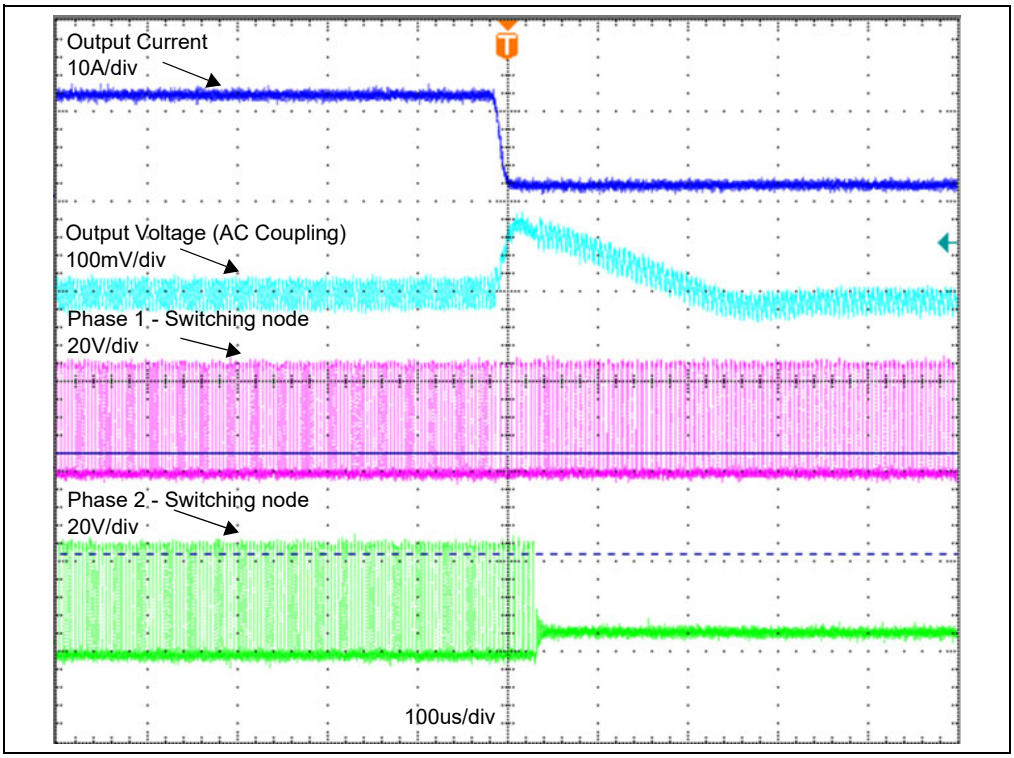

FIGURE C-6: *Load Transient with PSH from 12A to 2A at 24V.*

C.2 PERFORMANCE CURVES

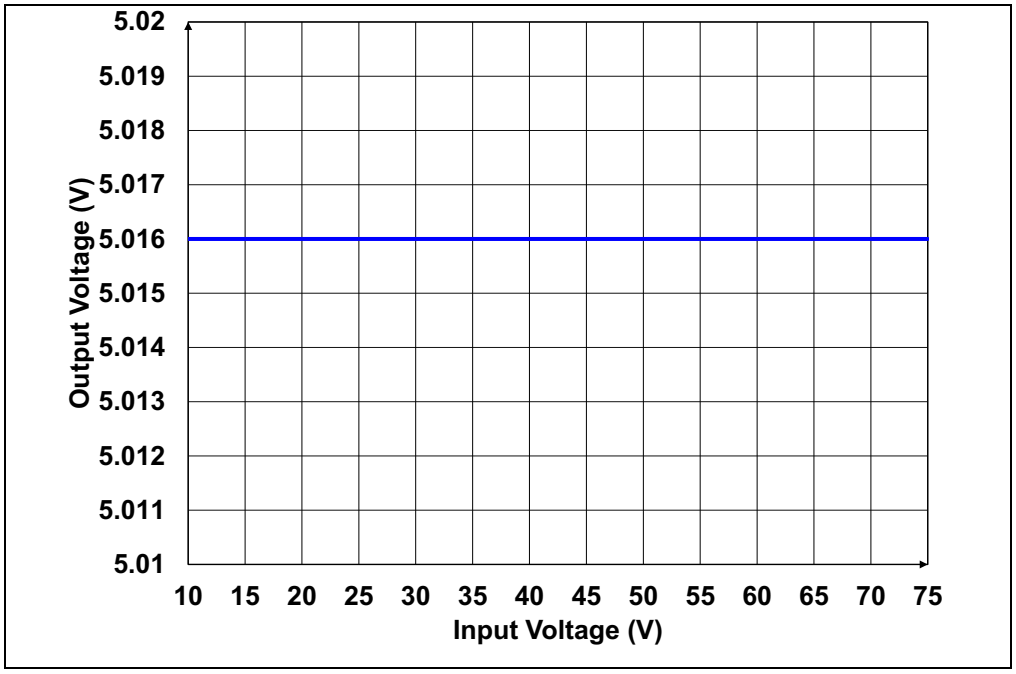

FIGURE C-7: *Input and Output Voltage.*

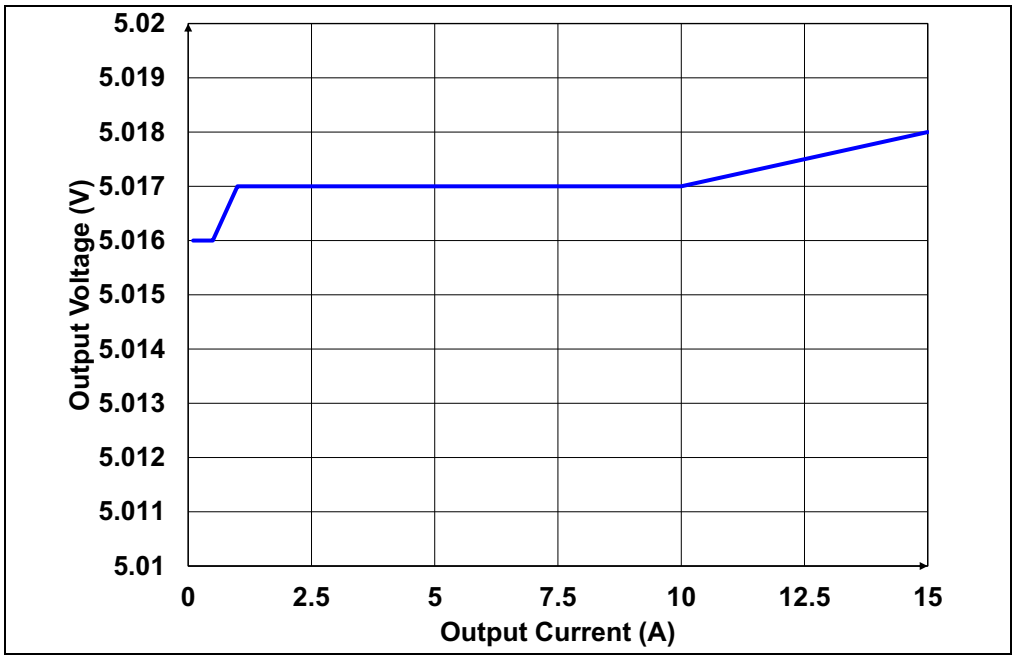

FIGURE C-8: *Output Voltage vs Output Current V_{IN} = 12V.*

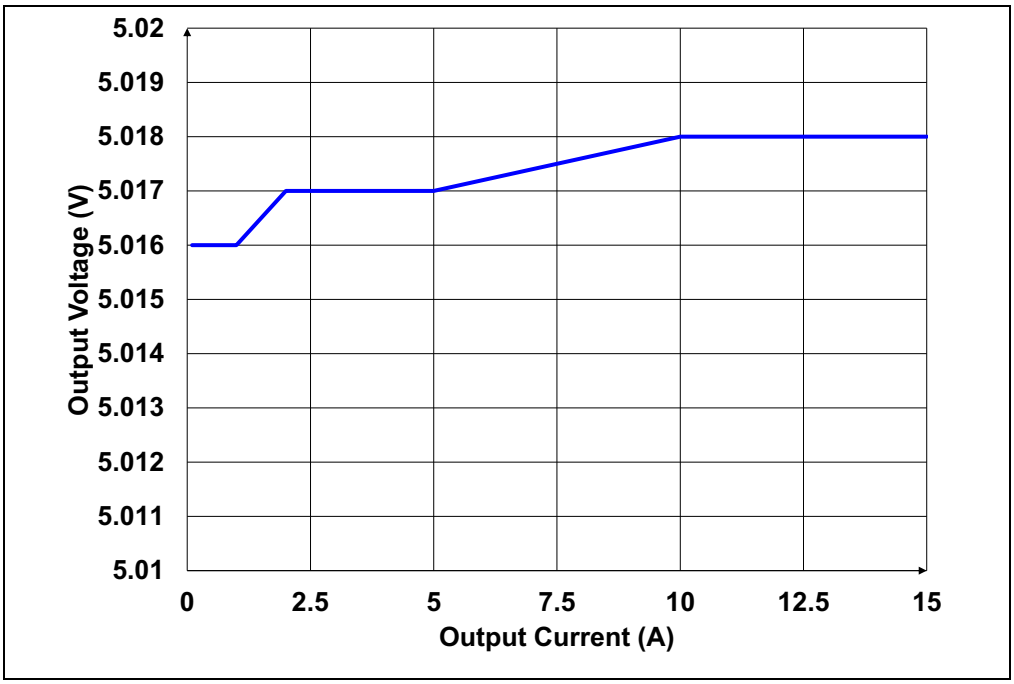

FIGURE C-9: *Output Voltage vs Output Current V_{IN} = 24V.*

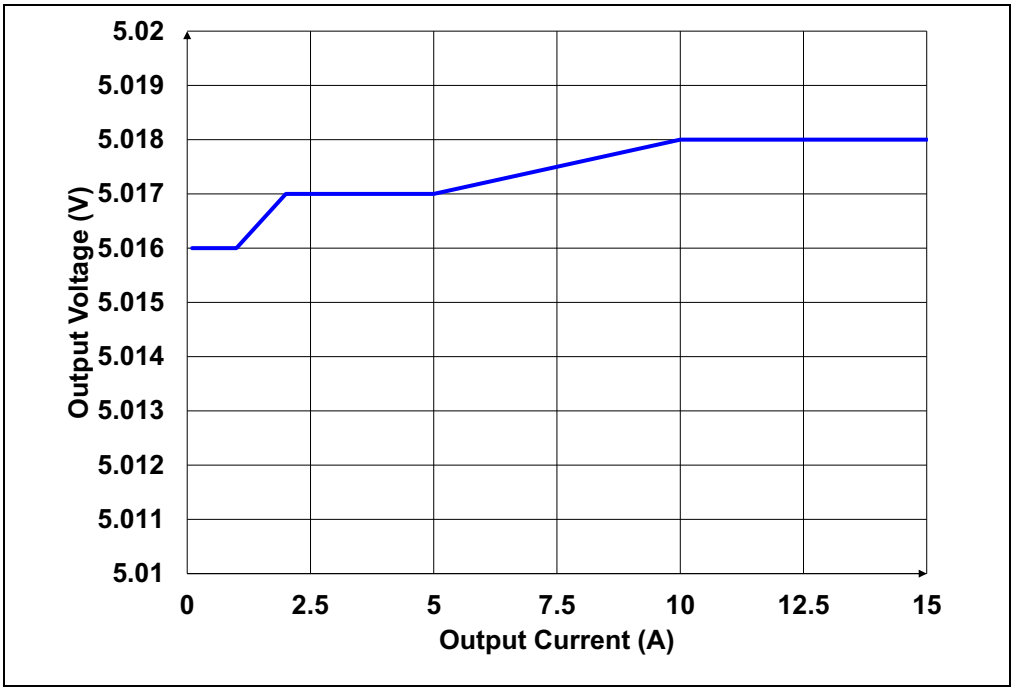

FIGURE C-10: *Output Voltage vs. Output Current V_{IN} = 48V.*

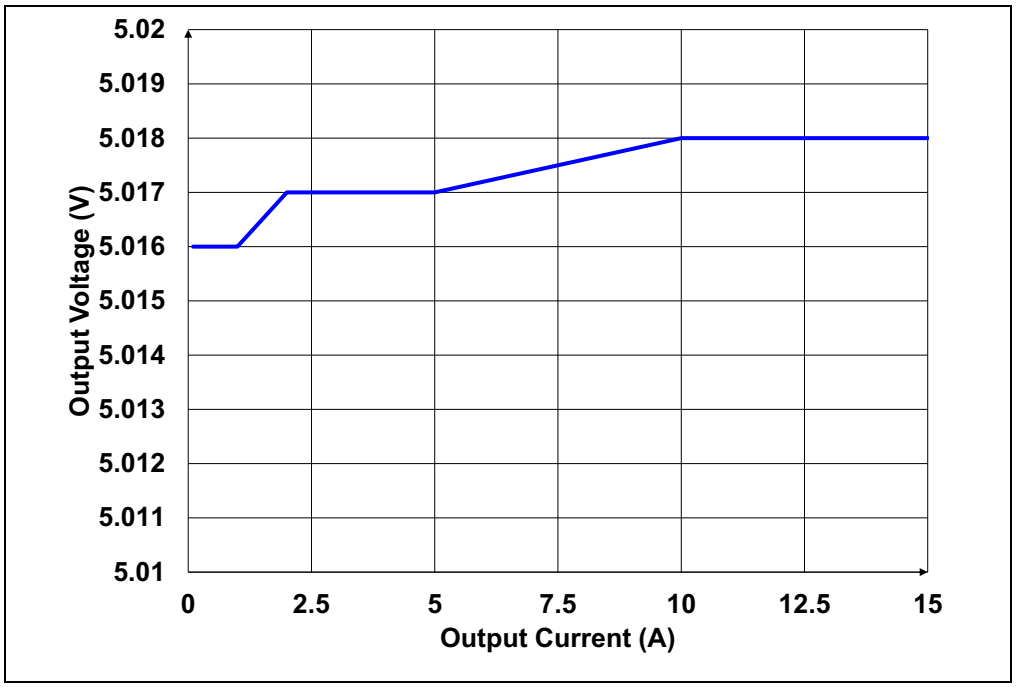

FIGURE C-11: *Output Voltage vs Output Current Vin = 60V.*

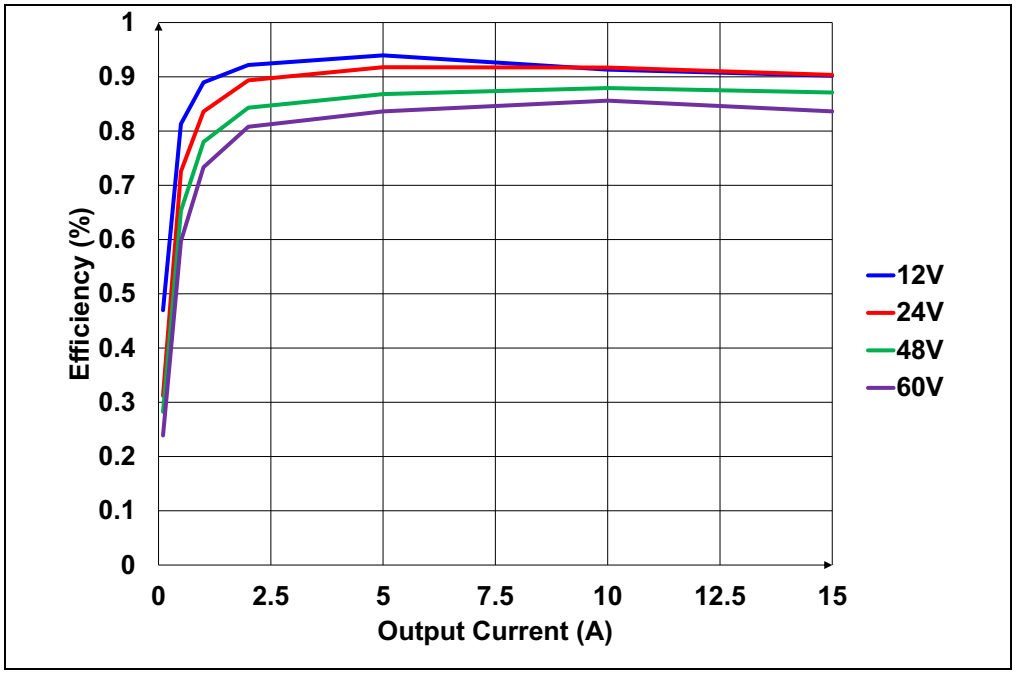

FIGURE C-12: *Efficiency vs Output Current.*

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